Geophysical Research Abstracts,
Vol. 11, EGU2009-10570, 2009
EGU General Assembly 2009

Application of one dimensional heat transport routine FEMME-STRIVE for groundwater-surface water interaction along the Upper Biebrza River, Poland

C. Anibas (1), O. Batelaan (1,2), J. Chormański (3), K. Buis (4), R. Verhoeven (5), and P. Meire (4)

(1) Vrije Universiteit Brussel, Department of Hydrology and Hydraulic Engineering, Brussel, Belgium (canibas@vub.ac.be), (2) Katholieke Universiteit Leuven, Department of Earth and Environmental Sciences, (3) Warsaw University of Life Sciences (SGGW); Sub department of Hydrology and Water Resources, (4) Universiteit Antwerpen, Department of Biology, Ecosystem Management Research Group (ECOBE) , (5) Universiteit Gent, Civil Engineering Department, Hydraulics Laboratory

As part of a multidisciplinary international research project, exchange processes in river ecosystems have been identified, assessed and modeled. The aim was to study the diverse physical, ecohydrological and biological processes in margins and inundation areas of water courses and how their interactions determine the exchange of water, dissolved compounds and particulate matter. To estimate these processes the ecosystem modeling platform FEMME was adopted to model several of these interaction processes. One of the most important transport processes results from the interaction of groundwater with the surface water body. Vertical groundwater movement can be estimated by using heat as a natural tracer by inverse modeling of the coupled heat advection-conduction-dispersion equation. FEMME uses numerical solutions for this equation, which can be solved both in steady-state or transient. Temperatures in the surface water and the riverbed have been measured continuously in piezometer nests along the upper river reach of the Biebrza in north-eastern Poland. The Biebrza River is part of the Biebrza National Park and one of Europe's biggest wetland systems. The upper reach is characterized by peat lands and extensive agricultural land use in the alluvial plains. As the applicability of the heat transport method is dependent on pronounced vertical temperature gradient, peat is a challenging environment as the soil structure is very heterogeneous and the heat capacities of the soil water matrix can be high, preventing thermal signals to propagate deep into the soil.

The numeric analysis of thermal data from piezometer nests provides a temporal distribution of exchange processes. To extend the information into a spatial distribution, 'roaming surveys' of temperature profiles with a purpose built instrument, the 'T-stick', have been performed along the 4 km long reach at several days between June 2007 and June 2008. Seepage meter measurements were performed to validate the heat transport model.

Continuously measured surface water temperatures were used to define the upper boundary conditions, whereas a quasi-stable temperature from a deep well is used to define the lower boundary of the model. These data was used to calibrate the vertical flux to the observed temperature profiles obtained from the T-stick measurements. Mapping these results of the inverse modeling shows the temporal and spatial distribution of vertical water exchange along the Biebrza River and indicates a highly variable interaction. The thermal method in general proved to be applicable under the physical conditions of peat, although with higher uncertainties than in other environments.